

UNITED STATES PATENT APPLICATION FOR

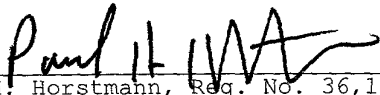
ACCESSING SERVICES  
ACROSS NETWORK SECURITY MECHANISMS

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**BACKGROUND OF THE INVENTION**

Field of Invention

5       The present invention pertains to the field of  
networks. More particularly, this invention relates  
to accessing services across network security  
mechanisms.

Art Background

10       A distributed computing environment commonly  
includes a variety of computing elements which are  
interconnected via a network. Examples of computing  
elements include computer systems, server systems,  
etc., as well as specialized devices having computing  
15       resources. The computing elements of a distributed  
computing environment may be arranged into one or  
more discrete networks such as local area networks  
and/or organizational networks which in turn may be  
interconnected via larger networks such as the  
20       Internet.

25       One or more of the computing elements in a  
distributed computing environment may provide  
services which may be accessed via a network. An  
example of a service is a web page. Another example  
of service is a distributed application program. In  
many applications, it is desirable to invoke a  
service on a particular computing element from  
another computing element via a network. For  
30       example, it may be desirable to enable a technician  
located at a diagnostic system to invoke a diagnostic  
program on a remote computing element without having  
to physically travel to the remote site.

One prior method for invoking a service via a network is to use web protocols such as the hypertext transfer protocol (HTTP). For example, Java application programs may be invoked on a remote  
5 computing element using HTTP commands.

Prior discrete networks commonly include security mechanisms for preventing unauthorized access from outside of the discrete network. One  
10 example of such a security mechanism is a firewall. Typically, HTTP commands sent by computing elements that are not appropriately configured cannot pass through a firewall. Unfortunately, such a security mechanism can present a substantial obstacle to  
15 accessing services from outside of a discrete network.

SUMMARY OF THE INVENTION

A device with mechanisms for accessing services across network security mechanisms is disclosed. A  
5 device according to the present teachings includes a set of computing resources for providing a service which is accessible via a network and a service handler that provides access to the service in response to an email message which passes through  
10 network security mechanisms unhindered. A device according to the present teachings may be embodied in a computer system or specialized device having computing resources or in a variety of other arrangements.

15 Other features and advantages of the present invention will be apparent from the detailed description that follows.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The present invention is described with respect to particular exemplary embodiments thereof and  
5 reference is accordingly made to the drawings in which:

**Figure 1** shows a network that incorporates the present teachings;

**Figure 2** illustrates the service handler which includes a mail handler and an HTTP server;

**Figure 3** illustrates a mail handler in one  
15 embodiment;

**Figure 4** illustrates a computing device in one embodiment.

**DETAILED DESCRIPTION**

5       **Figure 1** shows a network 100 that incorporates the present teachings. The network 100 includes a discrete network 10 having a firewall 24 behind which is a computing element 20, a mail server 22, and a web client 26. The computing element 20 executes a service handler 50 that supports a service 52. Although only the service 52 is shown, the service handler 50 may enable access to any number of services on the computing element 20 according to the present teachings. The network 100 includes a computing element 30 that accesses the service 52 through the firewall 24.

15               The computing element 20 has an email address which is associated with the mail server 22 and the computing element 30 accesses the service 52 of the computing element 20 by transferring an email message 40 to the email address of the computing element 20 using standard email protocols. The email message 40 passes through the firewall 24 to the mail server 22 and the service handler 50 obtains the email message 40 from the mail server 22. The service handler 50 then performs an access function specified in the email message 40. One example of an access function specified in the email message 40 is to invoke the service 52. Another example of an access function is to provide a command to the service 52 after it is invoked.

              In one embodiment, the email message 40 carries the service 52 along with a command that instructs

the service handler 50 to invoke the service 52. In response, the service handler 50 extracts the service 52 and associated parameters from the email message 40 and then loads and runs the service 52 using the computing resources of the computing element 20.

In another embodiment, the email message 40 carries a URL that specifies a source from which the service 52 is to be obtained along with a command that instructs the service handler 50 to obtain and invoke the service 52 from the specified URL. In response, the service handler 50 extracts the command and associated URL from the email message 40 and then obtains the service 52 from the specified URL using HTTP protocols. For example, the specified URL may correspond to a web server 32 which stores the service 52 and the service handler 50 uses HTTP commands to obtain the service 52 from the web server 32. The service handler 50 then install and runs the service 52 using the computing resources of the computing element 20.

In yet another embodiment, the service 52 is running on the computing element 20 and the computing element 30 uses the email message 40 to send commands to the service 52. For example, if the service 52 is a diagnostic program then the email message 40 may carry commands such as start diagnostic logging, stop diagnostic logging, and return information log, etc.

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A web client 26 may access the service 52 using HTTP protocols when the service 52 is running on the computing element 20. The service handler 50

generates web pages that enable the web client 26 to send commands and other information targeted for the service 52 using HTTP commands and the service handler 50 passes on the commands and information to the service 52 in response to the HTTP commands. The web pages also enable the web client 26 to obtain information from the service 52 using HTTP command and the service handler 50 obtains the information from the service 52 and passes on the information to the web client 26 in response to the HTTP commands. Alternatively, the web client 26 may access the service 52 using email messages using an appropriate mail server.

The email message 40 may include a response email address to which a response to the message 40 is to be sent. The response email address may correspond to the originator of the email message 40, the computing element 30, or some other email account. The service handler 50 sends a response message to the response email address. A response message may include status information regarding the success/failure of the command contained in the email message 40 and/or response information generated by the service 52.

The computing element 20 represents any device or system having computing resources and the appropriate hardware/software for obtaining the email message 40 from the mail server 22 and for loading and executing the service 52. Examples of the computing element 20 include computer systems, handheld devices, input/output devices, peripheral



5 devices including storage devices, printers,  
scanners, etc., specialized devices such as  
measurement and/or actuator instruments, wireless  
devices, appliances, etc., to name just a few  
examples.

10 The computing element 30 represents any device  
or system capable of sending the email message 40 and  
optionally receiving a response email message from  
the computing element 20. Examples include computer  
systems and handheld communication devices.

15 The service 52 may be a static file or an  
application program or other type of program. The  
service 52 may be embodied in software code that is  
adapted to the computing resources of the computing  
element 20. In an embodiment in which the computing  
element 20 includes a Java virtual machine the  
service 52 may be a Java application.

20 In an example embodiment in which the computing  
element 20 is a device having computing resources,  
the service 52 may be an application program that  
performs a diagnostic function on the device. For  
25 example, the service 52 may obtain diagnostic  
information, possibly by invoking utilities already  
present on the computing element 20, and transfer the  
diagnostic result information back in a response  
email message.

30 The service handler 50 includes the  
functionality of a web server that generates one or  
more web pages for the computing element 20. One or

more of the web pages of the computing element 20 provide links to the services running on the computing element 20. The service 52 once installed on the computing element 20 may be accessed by web  
5 clients through the web pages of the computing element 20. Web clients that may access the web pages of the computing element 20 include web clients within the network 10 and/or web clients outside of the network 10 that are configured to pass through  
10 the firewall 24.

The firewall 24 represents the appropriate hardware and software elements that function a bridge between the network 10 and elements on the network  
15 100. The firewall 24 does not pass HTTP commands from outside the network 10 that do not have an appropriately configured IP address.

In one embodiment, the service 52 and/or the  
20 command carried in the email message 40 is authenticated with a public/private key encryption. The computing device 30 digitally signs the email message 40 using a private key. The computing element 20 possesses the corresponding public key and  
25 uses it to authenticate the email message 40 once received. In addition, the email message 40 may be encrypted by the computing device 30 and decrypted by the computing element 20.

30 **Figure 2** illustrates the service handler 50 which includes a mail handler 70 and an HTTP server 72. In one embodiment, the device 20 includes a Java

virtual machine which supports the mail handler 70 and the HTTP server 72.

5       The mail handler 70 obtains email messages from  
the mail server 22 and in response performs the  
appropriate access function. An example of an access  
function is to invoke the service 52. Another  
example of an access function is to provide a  
command to the service 52 after it is invoked. An  
10       example of a command is a command that causes the  
service 52 to return log data to a return email  
address. In one embodiment, the mail handler 70 uses  
public keys to verify the originators of the received  
email messages.

15       The HTTP server 72 enables web clients such as  
the web client 26 to access the service 52. The HTTP  
server 72 generates web pages associated with the  
computing element 20 including web pages that provide  
20       links to commands associated with the service 52.

**Figure 3** illustrates the mail handler 70 in one  
embodiment. The mail handler 70 includes a message  
receiver 80 that obtains the email message 40 from  
25       the mail server 22. In one embodiment, the message  
receiver 80 is a POP3 email client. In another  
embodiment, the message receiver 80 is an SMTP  
message receiver. The message receiver 80 passes  
the email message 40 to a message parser 82. The  
30       following describes an example in which that email  
message 40 carries the service 52 along with a  
command to invoke the service 52.

The message parser 82 extracts the service 52 from the email message 40 along with the command to invoke. In response to the command to invoke, the message parser 82 passes the service 52 to the service launcher 84. The service launcher 84 invokes the service 52. In an embodiment in which the service 52 is a Java application program the service launcher 84 uses utilities provided in the underlying Java virtual machine on the device 20 to invoke the service 52.

The service 52 once it is invoked generates a service response which is passed to a message sender 86. The message sender 86 sends the service response in a response email message back to the reply email address of the email message 40. The service response may contain application-specific information.

If the email message 40 carries a command for the service 52 after it is invoked then the message parser 82 extracts the command from the email message 40 and passes the command on to the service 52. Any service response to the command is sent back to the originator of the email message 40 by the message sender 86.

**Figure 4** illustrates the computing device 20 in one embodiment. The computing device 20 includes a set of computing resources 100 along with a set of device-specific hardware. For example, the computing resources 100 may include processor hardware, memory, storage, communication hardware, etc., as well as

software support including an operating system and  
drivers, etc. If the computing device 20 is a  
printer then the device-specific hardware may include  
printing hardware, print memory, etc. The service 52  
5 along with a set of services 160-162 and the service  
handler 52 run on top of a virtual machine 102. The  
virtual machine 102 includes routines for accessing  
hardware and for sending and receiving messages using  
standard mail and web protocols.

10 In one embodiment, the service 52 is a  
diagnostic service that logs data associated with the  
device-specific hardware in the device 20. The  
computing element 30 may send a command in an email  
15 message to cause the service 52 to start logging data  
and later send a command to stop logging data and  
then send a command that causes the service 52 to  
return the logged data. Alternatively, the web  
client 26 may invoke these same commands using links  
20 provided on a web page generated by the service  
handler 50.

The foregoing detailed description of the  
present invention is provided for the purposes of  
25 illustration and is not intended to be exhaustive or  
to limit the invention to the precise embodiment  
disclosed. Accordingly, the scope of the present  
invention is defined by the appended claims.